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ON ASYMMETRY OF THE LOWER LIMBS
AS A CAUSE OF LATERAL SPINAL CUR-
VATURE, WITH A DESCRIPTION OF A
NEW METHOD FOR READILY AND AC-
CURATELY DETERMINING ANY VARIA-
TION IN THE LENGTHS OF THE LOWER
EXTREMITIES.

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On Asymmetry of the Lower Limbs as a Cause of Lateral Spinal Curvature,

WITH A DESCRIPTION OF A NEW METHOD
FOR READILY AND ACCURATELY DETER-
MINING ANY VARIATION IN THE
LENGTHS OF THE LOWER
EXTREMITIES.

I VENTURE to bring to your attention this evening several cases which illustrate the condition of lateral spinal curvature, with symptoms of a more or less severe nature, produced by inequality in the lengths or asymmetry of the lower limbs. Any defect of development producing a want of symmetry, if not recognized and properly corrected, in certain temperaments, and in favoring conditions, is liable to impair the general health, and, when a marked or excessive inequality exists, may in time even produce changes in the vertebral column, and in strumous subjects may induce even disease of the vertebræ, or abscess, with permanent deformity. At first the spinal curvature is simply accommodative, and is due to adjustment incident to the asymmetry; but if this defect is recognized sufficiently early the serious symptoms

which so often arise may generally be readily and entirely corrected. Defects of symmetry, which are seen in all parts of the body, have been especially observed in the face, the ears, and the chest; but the most marked and almost constant dissimilarity is seen in the lower limbs, where bilateral asymmetry is the rule rather than the exception.

The discovery of asymmetry in the lengths of the lower limbs dates back but a few years. During my term of service in the Pennsylvania Hospital, in the winter of 1873, I had under my care an adult with simple fracture of the femur. After his recovery I found, on careful measurement, that the injured limb was an inch longer than the other one. This was very puzzling and led to an investigation of the cause, which was at once suspected. My hospital resident and former pupil, Dr. Wm. C. Cox, now of Easton, Pennsylvania, then had his attention drawn to the subject, and he at once undertook a series of measurements, not only of those who had fractured limbs, but of sound persons who never had any injury. The results of these measurements were subsequently published in the *American Journal of the Medical Sciences* for April, 1875, by Dr. Cox, who is entitled to much credit for first demonstrating the facts in regard to asymmetry. The variations in the lengths of limbs were found to range from one-eighth of an inch to seven-eighths. In fifty-four persons examined, only six showed the lower limbs equal in length.

Subsequently, in December, 1879, I examined a large number of boys between the ages of eight and eighteen at the Girard College, Philadelphia, and found among five hundred and thirteen boys two hundred and seventy-

two presenting inequality in the lengths of the lower limbs. In two hundred and forty-one there was no appreciable difference in length. In one case there was a shortening in the right limb of three and one-quarter inches: this lad had, we found, suffered from a fracture of the thigh some years previously.

Each boy was interrogated with reference to previous injury, whether he had at any time had a fracture, or any bone or joint-disease which might have accounted for the defect.

The following results were obtained:

	91	showed	a	difference	of	$\frac{1}{8}$	of	an	inch.
100	“	“	“	$\frac{1}{4}$	“				
41	“	“	“	$\frac{3}{8}$	“				
22	“	“	“	$\frac{1}{2}$	“				
12	“	“	“	$\frac{5}{8}$	“				
2	“	“	“	$\frac{3}{4}$	“				
2	“	“	“	$1\frac{1}{8}$	inches.				
1	“	“	“	$1\frac{5}{8}$	“				

The right limb was found longer in one hundred and ninety-eight of the above two hundred and seventy-two asymmetrical cases. None of the boys, including those who exhibited the greatest shortening, were aware of the fact that one limb was deficient in length, although in nearly every instance an examination of the trousers-legs showed that they were much more worn at the heel on one side than on the other, and this condition at least had been recognized by the individual.

It is probable that, with the greater accuracy now obtained in measuring, a larger number of the above cases would have been found to be asymmetrical.

On the 10th of November, 1886, with the assistance of Dr. William Hunt and Dr. Thomas H. Andrews, I measured at the Haverford College forty-nine out of the class of nearly one hundred. These young men were, as a rule, well developed and accustomed to the usual athletic exercises. Of the number we examined, thirteen were about symmetrical. In one instance the shortening amounted to one-sixteenth of an inch.

18	showed a variation in the length of limbs of $\frac{1}{8}$ of an inch.
7	" " " " " $\frac{1}{4}$ "
7	" " " " " $\frac{3}{8}$ "
2	" " " " " $\frac{1}{2}$ "
1	" " " " " $\frac{5}{8}$ "

The right limb was shorter than the left in twenty-six of the forty-nine cases.

The fact that asymmetry in the lengths of the lower limbs may be looked upon as the rule, and not the exception, has been the means of settling at least one medico-legal case.

In 1878 an interesting suit for malpractice was tried before Judge Junkin, in New Bloomfield, Perry County, Pennsylvania. In this case an action for damages had been brought against Dr. Strickler, a medical practitioner of that place, who had treated a child aged 8 years for a fracture of the thigh, and, on recovery, the injured limb was found to be five-eighths of an inch shorter than the other. It was claimed that the boy was irretrievably ruined, although for a year he apparently had had perfect use of the limb.

During the trial the question of asymmetry prior to the fracture in a limb already shorter than its fellow was discussed. This led Drs. Agnew and Hunt, who were

present as medical experts, to measure the limbs of a lad of twelve years of age, a son of Dr. Strickler, who had never received any injury, and who happened to be present in the court at the time of the trial: the result showed a difference in this case of three-eighths of an inch in the lengths of the lower limbs. The presentation of this fact to the court promptly led to a nonsuit.

Thus ended, as Dr. Hunt has said, the first trial for malpractice in which the new facts as to measurements were brought with great effect before a legal tribunal.

It does not seem always possible to determine if these inequalities are congenital or acquired; probably most of the slighter, and even some of the more marked asymmetrical limb-defects, are congenital; but a careful investigation of the histories of the subjects of the more marked instances of shortening which have come under my observation induces me to entertain the belief that they are more frequently the result of infantile palsies, possibly overlooked or unsuspected. In some of the cases where an accurate history was obtained, the occurrence of some disease of the nervous system in early life has been revealed.

When there is no difference of circumference between the two limbs, yet a difference in their lengths, the defect is probably congenital or due to premature ossification of articulation-cartilages.

Disease of the nervous system in intrauterine life gives rise to arrest of development and variation in the lengths of limbs, and it is from this cause that we have all the various forms of congenital talipes.

The arrest of growth (which likewise occurs) in the course of an attack of infantile paralysis causes an inter-

ruption to the growth of the limb, which is seen in the atrophy which follows, and which is more or less marked according to the severity and duration of the attack. If the disease has been confined to one limb, or more marked in one than in the other, a variation in the growth is sure to be observed, and is commonly permanent.

In cases where the entire spinal cord on one side is involved, the pathological changes (and atrophy) involve all the structures, soft and hard, of the entire side so affected, and marked asymmetry is the result: this is to be seen in the face, chest, and breasts, in the diminished size of fingers and hand, as well as in the lengths of the limbs and feet. The parts so injured by the disease never regain more than a portion of what has been lost, and never attain the volume of the uninjured side.

It is difficult to understand why, in some instances of marked inequality in the lengths of the lower limbs, symptoms of such serious character should be experienced, while other cases of defects of symmetry should not give rise to any symptoms of spinal trouble, or, if any, so slight as to escape the notice of the individual.

Even organic changes, with rotation of the vertebræ, will occasionally occur from excessive and unrecognized shortening, as I have seen; but in such instances there was a predisposing strumous diathesis. In other cases the bodies of the vertebræ are less yielding and stronger, so that there is greater resistance to the unequal pressure.

Observation of a large number of cases has suggested to my mind the propriety, in every instance where there is continued backache or pelvic distress, especially among females,—symptoms which cannot be overcome by other

treatment,—of examining the lower limbs to determine the presence of any asymmetry. Such a course will clear up, I am confident, the diagnosis in many cases of supposed uterine and other complaints.

Very many persons who have asymmetry, and often with variations of more than an inch, are totally unaware of the defect: no special symptoms have occurred to make them recognize the defect. The existence of marked inequality, however, can often be detected in an individual when walking: such a condition commonly gives rise to peculiarities in gait; but any estimate of the actual shortening based on such an observation could not, of course, be relied upon. Frequently those who have inequality, however, have had their attention called to the defect from the fact (and perhaps none other) that the pantaloons-leg was worn on one side and not upon the other, and tailors having for some time recognized this fact, measure both limbs. In one case to which my attention was directed, where the inequality was an inch and a half, the person for more than twenty years recognized serious discomfort, and often pain in the back and loins, and had always selected, when walking in the street, the more elevated part of the sidewalk for the short limb, for very marked discomfort was soon experienced with the reverse.

The method I have introduced to determine the existence of any inequality in the lengths of the lower extremities in the same person is simple, readily applied, and accurate.

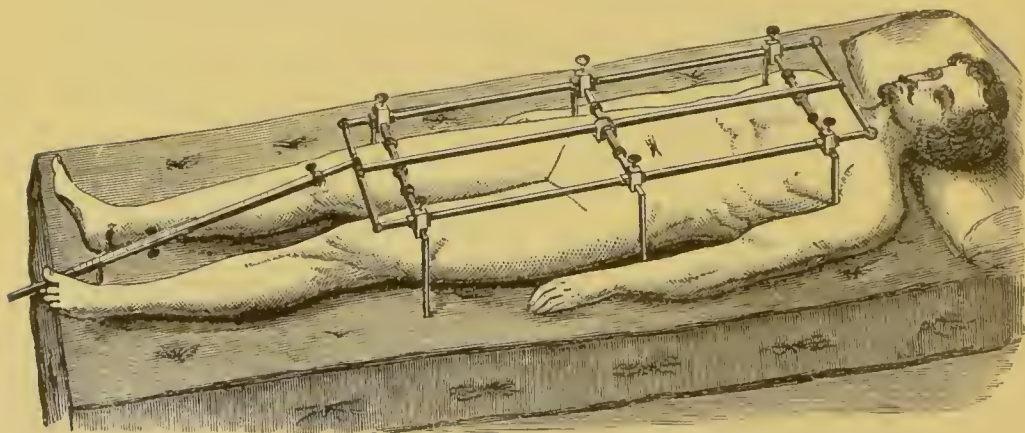
More than ten years since, I was so impressed with the inaccuracy of measuring with a tape-measure,—the only method then known of determining shortening,

especially after fractures of the thigh, etc.,—that I was led to devise an instrument (Fig. 1), which was at that time fully described by a former resident of the Pennsylvania Hospital, Dr. Stacy B. Collins, now of New York.*

Dr. Collins in describing this instrument says,—

“In attempting to accurately estimate the shortening which may take place after fracture, or coxalgia, etc., it seems necessary to have, first, a simple instrument that can be used on a patient in bed without disturbing any applied apparatus. Second, to have it of a material

FIG. 1.



which cannot be stretched. Third, to have both limbs measured from one fixed point, thus avoiding inaccuracies resulting from obliquities of the pelvis, differences in height of the iliac bones, and similar causes. Fourth, to have an instrument that not only shows the inequality, but accurately measures it at the same time. The instru-

**American Journal of the Medical Sciences*, 1877, p. 144. “Description of an apparatus devised by Dr. Thomas G. Morton for measuring any inequality in the lengths of the lower extremities.”

ment consists of two parts,—a steel frame, with movable arms; secondly, a measuring-rod extending from this, which passes between the legs, and by means of two short arms touches the internal maleoli at exactly the same relative point at the same time on both sides. When this is done the measurement is accomplished, as a scale on the extended rod at once shows and records any existing difference.

“When the frame is placed over the patient, one pair of steel arms clasps him under each axilla, a second pair holds the pelvis above the great trochanters, and with the legs strongly pressed out on each side the thighs come in contact with the third pair just above the knees: this allows the ankles to be two inches or so apart; the sliding-bar is now brought in requisition, and one of the small arms placed under one maleolus and the other upward or downward, as the case may be, on the other, and any shortening can at once be diagnosed.”

The manner of using is sufficiently simple, and when the measurement is carefully made, all sources of error (save possibly from an actual attempt to deceive) seem to be eliminated. It was with this instrument that I was, with the assistance of Dr. Cox and my son, able to make the fairly accurate measurements at the Girard College in 1879. Indeed, this instrument is now the only one with which accuracy can be obtained, if it is desired to measure the limbs when the patient is confined to bed or unable to stand erect.

The difficulty in using this apparatus was often so great as to seriously interfere with its ready application, so that measurements were not so frequently made. Subsequently I was led to devise the method which I

have now used for years, and which is the only one in use at the Orthopædic Hospital; it is one which can be at once readily put in operation, is absolutely accurate, and is applicable for every case and for all conditions; it consists in blocking up the short limb to correspond with its fellow. Measurements are made in the following way:

The individual to be measured should remove both shoes, stand upon a level surface, and the clothing should be removed sufficiently to fully expose the back from the neck to the heels, so that a complete rear view can be obtained.

There are four anatomical landmarks which must be considered,—

1st. The vertical normal line of the spine, made by the slight projection of the spinous processes.

2d. The vertical line, or cleft, between the nates.

3d. The horizontal, slightly-curved line which separates the buttocks from the thighs,—*i.e.*, the folds of the buttocks.

4th. The popliteal folds.

If the body is fairly symmetrical, these four anatomical conditions will be practically symmetrical, and consequently there cannot be any appreciable inequality in the lengths of the lower limbs; on the other hand, if asymmetry of the limbs exist, then changes at once will be observed; and just in accordance with the amount of shortening of one limb, so we will find a variation in the normal conditions referred to above.

1st. That the central line of spine will present more or less of a lateral deviation: the curve will be towards the defective side.

2d. The fold between the nates, which should be vertical, will deviate obliquely towards the short limb; but the most positive and readily noticed change will be found when the folds of the buttocks are examined.

3d. These curved lines should, with a symmetrical condition of the limbs, accurately correspond.

If, for example, the right limb is the short one, the gluteo-femoral crease, or buttock fold, will be below that of the other side, and just so much inferior to the other according to the inequality.

4th. The fold or horizontal crease often seen in the popliteal region will likewise show a variation; that of the longer limb will correspondingly be above that of the short side.

Now, if the short limb be sufficiently and gradually elevated, by placing a book, a block, or series of blocks or books, under the foot, or by any means at hand, the line of the buttocks will soon be made to correspond; and when this is accomplished, the cleft of the nates will be vertical, and the curve in the spine will be corrected, and the height the limb is elevated will at once indicate the actual amount of shortening.

Such measurements are readily and accurately determined; for this purpose I devised a series of blocks made of well-seasoned walnut wood; these blocks should vary in thickness from the $\frac{1}{16}$ of an inch to 2 or more inches; the set I have used for years are the $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 inch, $1\frac{1}{2}$, and 2 inches; from this set the slightest as well as the most marked irregularities can be determined; the blocks for greater convenience are made twelve inches long and four inches wide. At the Orthopædic Hospital I have also a series of well-seasoned boards, eight feet

long and four inches in width, and corresponding in thickness to the blocks; one of these boards is placed on the floor, and the height is readily increased to any extent by placing boards upon one another until the desired elevation is obtained; the patient is then directed to place the foot of the short limb upon the board or boards, and is then directed to walk forward, and the amount of shortening is practically determined when all irregularity in his walk is overcome; for greater accuracy the limb may then be blocked up as first described, and the two measurements can be compared, and the least overcorrection can generally be detected by the patient: after being made symmetrical, he quickly and readily notices any asymmetry.

This series of boards is especially useful and indicated when it is necessary to determine the proper elevation of heel required to give the greatest comfort to a patient in walking, who has recovered from hip or other limb disease with shortening or angular ankylosis, for it is only after such a practical test that a proper shoe can be constructed.

If any one with ordinarily symmetrical limbs will make the experiment of placing a block of one-fourth or one-half of an inch under one foot an asymmetrical condition will at once be experienced, and when this variation is corrected by blocking the opposite side, the subject experimented upon will at once be able to determine when the limbs are made equal; an under- or an overcorrection will be quickly appreciated.

The following cases will be quite sufficient for illustration of the subject:

CASE I.—SPINAL CURVATURE, WITH PARTIAL ROTATION OF THE VERTEBRÆ, FROM UNRECOGNIZED ASYMMETRY IN THE LENGTHS OF THE LOWER LIMBS.

On March 3, 1886, I exhibited to the Fellows of the College of Physicians the following case of lateral spinal curvature, the result of unrecognized asymmetry in the lower limbs. The history was briefly as follows:

A. H. F., aged 24 years, living in Wyoming County, a student of medicine, was a puny boy until about fifteen years of age, when he grew in fifteen months to his present height, five feet eleven inches. He has never been sick, except ordinary ailments of early childhood; has had more or less continued backache, which usually was relieved by a recumbent position. One year ago the diagnosis was made of necrosis of the lower dorsal and lumbar vertebræ, but no examination was ever made of the lower limbs, and consequently the asymmetrical condition was never recognized. A plaster jacket was applied a year ago, and worn for four months, when it was removed on account of the discomfort it caused.

On examination I found a very marked lateral curvature, which had not been improved by treatment, neither had the spinal pain been relieved; indeed, a gradual increase of suffering had induced the patient to relinquish his studies and come to this city for further advice. When he stood divested of his clothing I was at once struck with the very marked difference in the lengths of the lower limbs and the marked lateral curvature. Careful measurement showed that the right limb

was an inch and seven-eighths shorter than the left. It was found that when the short limb was sufficiently elevated the spinal curve was greatly lessened, but could only be partially corrected, for a certain amount of permanent rotation of the bodies of the vertebræ had taken place; this, with possibly some absorption of the intervertebral substance, had caused more or less deformity, with spinal rigidity.

The patient was directed to have the heel of his right shoe made one and seven-eighths of an inch higher than the other, and to support the uncorrected curvature a spinal brace was applied. Immediately after the limbs were made symmetrical the backache and loin-pains and most of the sciatic neuralgia and general uneasiness subsided.

Some two months later, during a chance visit made to Bradford County, I met this patient, whom I found in excellent physical condition, and free from pain and former spinal symptoms.

Under date of October, 1886, this patient wrote, "I am glad to report to you my present condition. You remember that I was unable to bend forward in the least; at present I can nearly touch the floor with my fingers. I have been very busy with my work; am using dumbbells and Indian clubs. My health is improving all the time. I am gaining steadily, and have no pains, and am feeling first rate; am increasing rapidly in weight."

Neither this patient nor any of his medical attendants had ever suspected that there was any difference in the lengths of his limbs. The well-marked spinal rigidity and the continued and increasing pain had naturally

suggested the existence of bone-disease or commencing abscess, which would not be surprising, for a strumous diathesis associated with such marked inequality in the lengths of the limbs would undoubtedly predispose to such results. When considerable lateral curvature occurs,—which must be the case when the inequality amounts to an inch or more,—the bodies of the vertebræ become rotated, and this, with other changes incident to unequal pressure, induces a deformity and other complications which in many cases, to a great extent, are irremediable.

Dr. Agnew tells me that he has a number of specimens which illustrate this pathological condition, interfering to a greater or less extent with the natural mobility of the spine.

CASE II.—SPINAL CURVATURE WITHOUT PERMANENT DEFORMITY, RESULTING FROM UNRECOGNIZED ASYMMETRY OF THE LOWER LIMBS.

W. F. W., aged 17, born in Philadelphia. For a long time he had considerable pain around his waist and back, which was more marked during and after any exercise; the pain he described as a tiresome ache, which was only relieved by lying down. When two years of age he had an attack of measles, and for a year was partially paralyzed on left side; he gradually overcame this, and now has nearly as good use of this limb as the sound one; while walking he could feel that he had a rather one-sided movement. Measurements showed that the right calf measured in circumference fourteen inches, the left one twelve inches, the right thigh seventeen and one-half inches, the left thigh sixteen and one-fourth inches;

in fact, the entire left side presented a moderate degree of atrophy as a result of the paralysis during early life. The right arm measured nine and three-quarters inches, the left arm nine inches. The left limb was one inch shorter than the right, and the left foot likewise showed diminished length of one inch as compared with its fellow.

The unequal length of the left side has been made up by a corresponding height of the heel, which gives perfect symmetry, and since the inch to the heel has been adjusted he has been entirely free from all pain and walks without the slightest lameness: he has, however, some difficulty in bending the body to the floor; but this symptom in time is likely to disappear, as I have observed in other cases.

CASE III.—LATERAL CURVATURE WITH SPINAL PAINS FROM UNRECOGNIZED ASYMMETRY OF THE LOWER LIMBS.

W. M. J. S., born in Philadelphia, aged 25, consulted me early in the winter for severe and continued back-ache; this commenced more than a year ago, and has been a source of great discomfort ever since. About twenty years ago he had an abscess near the right ankle, which he completely recovered from, but again five years ago he had a return of this trouble, and at the same locality, which, however, soon yielded to treatment. There is no evidence that the bone was ever involved in the disease, for no exfoliation has ever occurred.

The pain which this patient had was not confined to the back, but it extended to the right hip and side. When he would attempt to straighten up and stretch his

back, he would experience a cramp-like feeling; the pain at times extended to the scrotum; he had also been treated for two years for supposed renal complications. In other respects his general health had been excellent, and there was no history of any strumous disease. He had in bending over considerable stiffness in the back,—a similar condition to that observed in many of these cases where the curvature of accommodation has continued for a length of time.

An asymmetrical condition was found to exist throughout the entire right side, and was probably congenital, for there was no history of any infantile paralysis. The measurements of the limbs were as follows. The right arm measured ten inches in circumference, the left arm ten and one-half inches; the right calf measured eleven inches, the left calf thirteen inches. The right limb was shorter than the left one and five-eighths inches.

To overcome the shortening of the right limb the heel of the shoe on this side was made one and five-eighths inches higher than the left; with this change the spinal deformity was nearly rectified, and he was able to walk without lameness, and the pain at once entirely disappeared. He has since, now ten months, been free from all former symptoms, and has had uninterrupted good health.

In order to present the abnormal conditions which are readily observed in inequality in the lengths of the lower limbs, I had this patient photographed, with the following result:

Fig. 2 shows an elevation of the right shoulder which is usually seen, probably from the fact that the individual

unconsciously endeavors to rectify the inequality in the limbs by stretching the entire side to equalize the irregularity, and so the shoulder is elevated. The curve in the spine is observed deviating towards the right side; the

FIG. 2.



distance between the spinous processes and the right and left side is marked; the line of the cleft of the nates is oblique, and the line or fold of the buttock on the right side is below that of the left side; this same want of regularity is also seen in the popliteal folds when the right and left side is compared. There is also a general flatness of the right buttock. The diminished size of the right limb as compared with the left will at once be observed; a variation exists not only in the thighs, but in the upper extremity, although the individual has never appreciated any difference in regard to the strength of the limbs.

Fig. 3. The right limb has been blocked up one inch and five-eighths, which exactly corresponds to the shortening; all deformity is overcome, the shoulders are symmetrical, the spinal column is vertical, the cleft of the

nates is vertical, the folds of the buttock and the popliteal region are on a line with each other, and the general anatomical fulness about the right buttock is restored.

FIG. 3.



FIG. 4.



Fig. 4. The same block has been placed under the left or the longer limb; supposing that there has been an error, and that the right limb is equal in length with the left, then the block placed under the left foot should not give rise to any deformity. The result shows an increase of deformity over that shown in Fig. 2, the shoulder is more elevated, the spinal curvature is in-

creased, the obliquity of the nates more marked, the right buttock or gluteo-femoral fold is seen much below that of the left side, and, finally, a greater variation between the crease in the right popliteal region as compared with that on the left side,—in fact, the shortening of the right

FIG. 5.



side has been increased, the original variation of an inch and five-eighths has been doubled by the addition of the block, so that the shortening of the right side has been increased to three inches and a quarter.

Fig. 5. Same as Fig. 4, the subject not having changed position; the view was obtained by simply moving the camera to one side, demonstrating a lateral view of the increased deformity resulting from the natural and acquired shortening of the right side equal to three inches and a quarter.

Considering all that has been published in regard to asymmetry in the lengths of the lower limbs, it is noteworthy that Sir James Paget, so late as January, 1886, in an article on "Imperfect Symmetry" (which should cover the subject of the defects of symmetry), should have failed to state the fact that the discovery that in-

equality as to the lengths of the lower limbs is the rule, and not the exception, was made in the Pennsylvania Hospital in this city.

That distinguished authority on fractures, the late Dr. Frank H. Hamilton, who was at first unwilling to admit the important new facts as to measurements, subsequently wrote Dr. Hunt, some time after the discovery of asymmetry, as to the lengths of the lower limbs, "I think the subject of sufficient importance and so creditable to American surgery as to entitle it to a more conspicuous notice and a faithful historical record."

Mr. Paget, in his article, already referred to, on "Imperfect Symmetry" in the *American Journal of the Medical Sciences*, says, "The inequalities of the limbs have been so fully studied that I need only refer to the papers of Dr. Garson in the *Journal of Physiology* and to those which he quotes." "He shows clearly that the two corresponding limbs are very seldom of the same length." Mr. Paget further says, "Difference of volume is often as marked as is that of length, and it is sometimes sufficient to suggest suspicion of disease. But the suspicion may generally be dispelled on finding that there neither is now nor ever has been any sign of disease in either limb, and that it is difficult to say which of the two unequal limbs is the better or the more appropriate to the other parts of the body." "The difference of length has usually more importance in practice, for it may be associated with appearances of deformity resembling those which are due to really morbid shortening of a limb, such as may ensue in the defective growths during infantile paralysis, or disease of the hip or knee, or any similar affection. Many cases of suspected slight cur-

vatures of the spine are only examples of the adjustment due to inequality of the lower limbs, and in every such case they should be measured and compared."

While such a close observer as Hyrtl notices the differences in length of the upper extremities, he seems to deny that they exist in the lower ones without making themselves manifest by a limping gait. Thus, he says,—

"Both of the *upper* extremities are seldom of the same length. The difference is in favor of the right by two or three lines. From congenital causes the differences may be greater, but do not, except in cases of great deformity, betray themselves so readily as those of the lower extremity, which become manifest by limping. Also, the strength of the upper extremities is seldom equal. This is not owing to the greater use of the right, but there is an original difference in the muscular development of both extremities in favor of the right one, which gives to this a marked prevalence over the left. We use the right extremity more than the left because it is the stronger, but it did not become the stronger because it was more used."

"The relation of the whole muscular mass of the body, taken from exact weighings of four subjects, was, right to left, 1:09527. But relation of the different parts of the bodies was not alike. They were, right to left, as follows:

Head and trunk = 1:0992.

Lower extremities = 1:0936.

Upper extremities = 1:0929.

A difference of over seven per cent. in the upper extremities."

Of the lower extremities in this connection, Hyrtl remarks,—

“Although the strength of the lower extremities is not the same, and the right prevails over the left, *yet their length must be precisely alike*. Small congenital or acquired differences betray themselves through a limping gait.”

It is most curious that Hyrtl, who noted changes in the upper extremity so closely, should have made the statement he does, for the accommodative conditions of man are so fertile that we find a very large proportion of asymmetrical short-legged persons who have never been injured, show no limping whatever, and yet with differences varying from one-fourth of an inch to an inch or more. Dr. Hunt says, “To me it (differences in lengths of limbs) more than any other factor accounts for the different natural gaits of different individuals, who from the beginning have accustomed themselves to it without limping, not knowing they were lopsided.”

Professor Joseph Leidy has written me: “In the course of my studies in zoölogy and comparative anatomy I have had occasion almost incessantly to notice more or less abnormal symmetry in contradistinction to that which must be considered normal,—as the usual want of symmetry in the abdominal digestive apparatus, in the development of the female generative apparatus on one side only in birds, etc. It would appear as if there was even great difficulty in maintaining ordinary bilateral symmetry. In the cetaceans the nose commonly exhibits more or less want of symmetry, and in man I have never found complete symmetry throughout the nasal cavities. I have nowhere read of obser-

vations like yours on the subject, which appear to me to be so important in their practical application."

My friend Mr. O. S. Hubbell, formerly of Philadelphia, now of Stratford, Conn., I knew had some personal experience in being the owner of a fine horse which was asymmetrical in his right fore and hind leg, and I wrote him on the subject. Mr. Hubbell's reply was received just before the meeting of the Academy of Surgery on June 7 last, and I was unable at that time to incorporate the following extract of his interesting letter on the subject, which I now quote :

"Many common beliefs, such as the current one taught in our catechisms, that man, some centuries ago, was perfect (without evil tendencies or maladies), overrules every logical paleontological induction, and contradicts our experiences. The common assumption that perfect bilateral symmetry prevails in the human organism precludes our recognition of the actual great disparities in correlative features. In trees the factors of diversity (winds, light, nutrition, etc.) are not uniformly distributed, and hence the variations that are so conspicuous.

"There is a striking likeness between the two halves of animals, or organs on opposite sides of the bodily axis, but great disparities may exist that do not affect the gait or attract the attention of the individual or spectators. I have witnessed men with an inch difference in length of limbs who were utterly unconscious of it. The strides were equable, just as in the case of my saddle-horse Greive, with whom the difference in limb-length was two inches, yet his gait was remarkably equable. A practised eye could detect the greater angles in the articulations on one side, which arose without the interaction

of will, from the necessities of the stride. Let the bilateral likeness be ever so great, a good observer will discover discrepancies which escape the notice of the individual possessing them and of other observers. No human face is ever alike on both sides, nor in any feature of it. The great models of the antique present no perfect bilateral resemblance, and if they were alike in a work of art, we should at once say the artist had not studied nature. You have a noted artist in your city who got his mental images through careful studies in his youth, but is unable to paint a Jersey though he have the animal before him,—the mongrel features of his early studies are reproduced unconsciously on his canvas. We see things as we think, not as they really are. Though we now know that sunrise is caused by the turning of the earth, still our early notion that the sun rises still prevails, and will until we are taught earlier the truth. The two sides of no man are alike in anything, yet not one in a thousand ever discover it in themselves. That a man finds one limb longer than the other after recovery from fracture is no proof that they were not even more unlike before, and to discover just what the difference now is you will have to resort to stratagem or put the man under some anæsthetic, for his simulation of discrepancy is or may be quite unconsciously affected by the will or belief of the person, and this must be antagonized to get the actual result.

“Just as educated men have outgrown the belief in the original ‘perfection’ of mankind, so artists have outgrown the prevailing belief in the equality of the two sides of the human body or bilateral likeness.

“The variation of but one-tenth of an inch in the

perfect circularity in the tire of the carrying wheels of a locomotive has been known to squander energy enough (measure in cost of extra consumption of coal) in a few years to buy a new locomotive, while the shock of incessant concussion on the road and to the locomotive itself, are still further aggravations. Such small deviations from symmetry in motive machines have vast significance, yet the sequences of human asymmetry, so overwhelmingly important to intelligent life, have scarcely realized the attention of practitioners or been brought within the scope of practice, nor even recognized until disaster has arisen, possibly at a period of organic development when the physician can play the part only of a tinker instead of as a builder or re-builder.

“The initial causes of asymmetry present a new field for directive judgment and exploration. The omnipotence of reacting circumstance (pre- and post-natal) is usually overlooked in our attempts to attain equable-acting motive-structure. Neither element nor organ disclose to observation how either will act until reacting circumstance has been estimated.

“The measure of one limb gives no certain knowledge of what the length of the other is or was before fracture. My guest now with me was asked a moment ago to stand close against the wall while I measured his height. The supreme height was taken when he quite unconsciously was standing on one foot flatly, while the toe of the other only rested on the floor, showing the greater length of one limb.”

My colleague at the Philadelphia Orthopædic Hospital, Dr. H. E. Goodman, tells me that during the many years of his service as pension-examining surgeon

for the United States government he has had a great number of applications for pension for disabilities described as lumbago, said to have been the result of injuries or exposure during the late war. Dr. Goodman states, that in nearly all of these cases, upon a careful examination, he has found a previously unrecognized asymmetry of the lower limbs, and that the backaches and spinal symptoms described as "lumbago" were unquestionably due to this cause.

It is not claimed that in all cases of inequality in the lengths of the lower limbs there is necessarily a *true* lateral spinal curvature or permanent deformity from rotation of the vertebræ, for we constantly find marked and even excessive inequalities in the lengths of the lower limbs which have never given rise to any symptoms of spinal disease; indeed, in many cases marked asymmetrical defects have existed which have never been recognized by the individual, but it is nevertheless a fact that in many instances, long-continued slight and severe backaches, with loin and pelvic pains, involving the distribution of the sciatic nerve, are due to the constant "shocks" the trunk is subjected to as a result of bilateral asymmetry, and that such cases are absolutely and permanently relieved simply by correcting the asymmetry of the lower limbs; in many cases these symptoms appear in asymmetrical individuals who have previously enjoyed good health, when from depressing physical conditions, with nervous complications, the way is made easy for the occurrence of the symptoms already described.

The histories of the cases which have been presented to the Society for inspection, from a very large number which I have had under my care, demonstrate, I think,

very conclusively that spinal curvature can be induced (with more or less marked deformity) by unrecognized asymmetry, and that by simply correcting defects of symmetry the distressing and apparently serious symptoms so often observed are promptly and permanently overcome.

The subject is one of so much interest and practical importance that I am confident it will receive not only the careful consideration of the Fellows of this Academy, but the attention of the profession generally.

1421 CHESTNUT STREET, PHILADELPHIA,
December, 1886.